

with merry dancers, extending up to altitude 80°; its maximum brilliancy occurred at 11 p. m., and the display ended at midnight.

Burlington, Vt.: a very brilliant aurora was observed from 9 p. m. to midnight of the 20th; waving flashes of light extended from altitude 10° to the zenith.

Lansing, Mich.: an aurora was observed from 9.10 to 11 p. m. on the 20th, consisting of two arches, the lower one having an altitude of 25°. Streamers shot up at intervals from the lower arch to an altitude of 40°.

Clinton, Clinton Co.: an auroral arch extended from east to west and to an altitude of 40° from 9 to 10 p. m. on the 20th.

Manchester, N. H.: an aurora was observed at 9.30 p. m., 20th, as a narrow, irregular arch above a dark segment; the arch extended to altitude 30° and covered 100° of the horizon; the aurora increased slightly in brilliancy after 10.15 p. m., when faint merry dancers appeared along the upper edge of the arch, shooting upwards to the zenith.

Mr. A. G. Wolf, the light-house keeper at Atlantic City, N. J., reports having observed an auroral arch, resting on a dark segment 10° high, from 10.30 p. m. on the 21st until 3 a. m. on the following date; the arch extended to altitude 45° and covered about 79° of the horizon.

Auroras were observed on the several dates during the month as follows; 1st, Oakland, Cal.; Traverse City, Mich.; Fort Assinaboine and Poplar River, Mont. 2d, Clayton, Egg Harbor City, Moorestown, N. J.; Quakertown, Pa.; Burlington, Vt. 3d, Kalamazoo, Mich. 4th, Parkston, Dak. 5th, Quakertown, Pa. 6th, Hartford, Conn.; Saint Vincent, Minn.; Fort Custer,

Fort Maginnis, and Poplar River, Mont. 7th, Voluntown, Conn.; Bismarck, Fort Buford, Fort Yates, Leach Farm, and Webster, Dak.; Eastport and Orono, Me.; Blue Hill Observatory, Cambridge, and Provincetown, Mass.; Alpena and Marquette, Mich.; Moorhead and Saint Vincent, Minn.; Fort Custer, Fort Maginnis, and Poplar River, Mont.; Nashua, N. H.; Oswego, N. Y.; Burlington and Northfield, Vt. 8th, Rapid City, Dak.; Eastport and Orono, Me.; Saint Vincent, Minn.; Poplar River, Mont. 9th, Smithland, Iowa; Eastport, Gardiner, and Orono, Me.; Saint Vincent, Minn.; Poplar River, Mont. 10th, Parkston, Dak. 12th, Saint Vincent, Minn. 15th, Saint Vincent, Minn. 18th, Parkston, Dak.; Nashua, N. H. 20th, New Haven, Conn.; Leech Farm, Dak.; Amana, Clinton, Cresco, Dubuque, Maquoketa, Monticello, and Osage, Iowa; Eastport, Gardiner, and Portland, Me.; Blue Hill Observatory, Boston, Cambridge, and Provincetown, Mass.; Grand Haven, Lansing, and Thornville, Mich.; Saint Vincent, Minn.; and Poplar River, Mont.; Manchester and Nashua, N. H.; Moorestown, N. J.; Buffalo, Ithaca, Lyons, Oswego, Rose, and Senauket, N. Y.; Elyria, Bellevue, Garrettsville, Sandusky, Tiffin, Toledo, Wauseon, and Yellow Springs, Ohio; Erie, Catawissa, State College, and Wellsborough, Pa.; Burlington, Vt.; Beloit, Delavan, Deuster, and La Crosse, Wis. 21st, Kent's Hill, Me.; Poplar River, Mont.; Albany and Ardenia, N. Y.; Dyberry and Erie, Pa. 22d, Atlantic City, N. J.; Detroit, Mich. 27th, Fort Maginnis, Mont. 28th, Parkston, Dak.; Traverse City, Mich. 29th, Parkston, Dak.; Lyons, N. Y.; Milwaukee, Wis. 30th, Windsor, Ill. 31st Saint Vincent, Minn.

MISCELLANEOUS PHENOMENA.

DROUGHT.

Limona, Hillsborough Co., Fla., 3d: vegetation is suffering greatly for rain.

Savannah, Ga., 4th: no rain has fallen since April 23d, when a slight thunder shower occurred, and vegetation is suffering. Previous to the rains of the 9th drought prevailed in this section, causing injury to vegetation in general.

University, Miss.: the rains of the 4th and 5th were of great benefit to crops, which had been suffering seriously from drought.

Augusta, Ga., 7th: on account of the prevailing drought the oat crop has been seriously injured; cotton and truck farming interests have also sustained some injury. Rain fell on the 8th, and though very light, it was of great benefit.

The voluntary observer at Prospect, Bermuda Island, reports that the total precipitation for May, 0.63 inch, was the least recorded in that month during the last nine years; the next smallest amount in May, being 2.37 inches.

FOREST AND PRAIRIE FIRES.

Chatham, Barnstable Co., Mass., 9th: a forest fire destroyed much valuable woodland in the vicinity of South Brewster, in this county.

Prairie fires are reported to have occurred at Moorhead, Minn., on the 1st, 4th, 8th, 15th, 18th, and at Saint Vincent, Minn., on the 10th.

HALOS.

The dates on which solar halos were observed over the greatest extent of territory during May were the 6th, 17th, 21st, and 23d; they were least numerous on the 7th, and from the 13th to 15th. They were observed on from ten to fourteen dates in Dakota, Kansas, New York, Tennessee, and Washington Territory; Dakota reporting the maximum. None were reported from Arkansas, Florida, Louisiana, Missouri, New Mexico, and Rhode Island.

Between the 1st, and 16th, and from the 26th to 31st, very few lunar halos were reported, there being eight days of the first named interval on which none were recorded; from the

17th until 25th, inclusive, they were quite numerous, being observed in twenty-two states or territories on the 21st. They were seen on from six to eleven days during the month in Arizona, California, Iowa, Kansas, Pennsylvania, Texas (maximum), and Virginia. None were reported from Georgia, Idaho, Indian Territory, Maine, Michigan, New Mexico, Rhode Island, Utah, Washington Territory, and Wyoming.

The Chief Signal Officer has received through the Honorable Secretaries of State and War an interesting photograph of a solar corona which was observed at San José, Costa Rica, May 1, 1888, concerning which the United States consul at Costa Rica, who forwarded the photograph to the State Department, reports as follows: "The circle was apparent from 10 a. m. to 1 p. m., and three colors of the rainbow, red, blue, and yellow, showed in the white circle, although not represented in the photograph."

The phases of the moon, Washington mean time, during May, as given in "The American Ephemeris and Nautical Almanac," are as follows: last quarter, 2d, 6h. 38.9m.; new moon, 10th, 8h. 15.3m.; first quarter, 18th, 5h. 57m.; full moon, 24th, 20h. 31.9m.; last quarter, 31st, 19h. 45.1m.; apogee, 9th, 8.1 h.; perigee, 24th, 1.6 h.

METEORS.

Keeler, Cal.: a meteor of extraordinary size and brilliancy was observed on the evening of the 12th at 10.15 p. m. It was first seen in altitude 23° and azimuth 90°, and remained visible for fifteen seconds. It moved in a horizontal line to azimuth 40° where it disappeared behind the Sierra Nevada mountains. The size and brilliancy of the meteor were equal to the full moon, and it left a fan-shaped trail fully 20° in length, which remained visible until the disappearance of the meteor.

Meteors were also observed as follows: 1st, Fort Stanton, N. Mex.; Wauseon, Ohio. 2d, Quakertown, Pa. 3d, Cedar Keys, Fla. 4th, Lead Hill, Ark. 5th, Ithaca, N. Y. 6th, Cairo, Ill.; McMinnville, Oregon. 7th, Cleburne, Tex. 8th, Wilmington, N. C. 11th, Cedar Keys, Fla. 12th, Clear Lake,

Iowa. 17th, Cedar Keys, Fla. 18th, Fort Thomas, Ariz. 19th, Clear Lake, Iowa; Springfield, Mo. 21st, Toledo, Ohio. 28th, Madison, Wis. 29th, Quakertown, Pa. 30th, Cleburne, Tex.

MIRAGE.

Grand Haven, Mich.: mirage was observed over Lake Michigan from 5.25 until 5.50 p. m., 6th, the phenomenon extending from the southeastern shore to the northwestern horizon. Vessels about five miles from shore appeared both in a natural and inverted position. There was about three feet of sea running at the time and the waves were distinctly seen, apparently seventy-five feet above the surface of the Lake. In the southeast the forests along the shore were plainly depicted in the sky in inverted positions, while to the northwest the image, blurred, gave the vessels a phantom-like appearance.

Huron, Dak.: a mirage was observed from 7 to 8 a. m., 14th. Distant objects in all directions appeared very near and elevated; railroad trains were seen moving as on a horizontal column of smoke.

The following is an extract from the Manchester, N. H., "Daily Press" of the 29th:

This wonderful phenomenon of nature was clearly seen from the hills of Dunbarton between 7 and 8 o'clock Sunday morning, 27th. As far as the eye could see from a point in the east, extending southerly to a point due west, the

face of the surrounding country was reproduced upon the clouds above the horizon. To see such a large area of mountains and plains, hilltops and valleys, fields, and woodlands, dwellings, and highways, covering hundreds of miles, and, at the same time, their exact counterpart far above the clouds, is a marvelous sight and one to be enjoyed but once in a lifetime.

Port Angeles, Wash., 28th: the city of Victoria and bays and lakes on Vancouver Island, B. C., were distinctly visible throughout the greater portion of the day. Objects appeared very much raised and, at times, standing upon each other. The day was nearly calm and clear.

Mirage also occurred as follows: 1st Yuma, Ariz.; Independence, Iowa. 5th, Leech Farm Dak. 7th, Webster, Dak. 8th, Yuma, Ariz.; Leech Farm and Webster, Dak. 9th, 12th, and 13th, Webster, Dak. 14th, Webster, Dak., and Moorhead, Minn. 15th and 16th, Webster, Dak. 17th, Moorhead, Minn. 18th, Parkston, Dak. 20th, Tribune, Kans. 21st, Parkston, Dak.; Moorhead, Minn. 25th, Webster, Dak. 28th, Marquette, Nebr. 29th, Webster, Dak.; Tribune, Kans. 30th, Salina and Tribune, Kans. 31st, Webster, Dak.

SAND STORMS.

Sand storms were reported as follows: Yuma, Ariz., 4th, 15th, 16th, 20th, 25th; Duluth, Minn., 7th; Rio Grande City, Tex., 14th, 26th; Fresno, Cal., 14th, 30th, 31st; Whipple Barracks, Ariz., 15th; Las Vegas, N. Mex., 15th, 16th, 25th; Willcox, Ariz., 28th.

VERIFICATIONS.

INDICATIONS FOR 33 HOURS IN ADVANCE.

The percentages of verifications of the tri-daily indications for May, 1888, as determined from comparison of succeeding telegraphic reports, are given in the table below.

The predictions for all districts east of the Rocky Mountains for May, 1888, were made by Junior Professor H. A. Hazen, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Junior Professor C. F. Marvin.

Percentages of indications verified, May, 1888.

States.		States.	
Maine.....	66.68	Kentucky.....	79.00
New Hampshire.....	70.39	Ohio.....	75.77
Vermont.....	68.03	West Virginia.....	75.13
Massachusetts.....	67.32	Indiana.....	70.71
Rhode Island.....	71.45	Illinois.....	77.87
Connecticut.....	67.65	Lower Michigan.....	77.29
Eastern New York.....	69.65	Upper Michigan.....	69.94
Western New York.....	76.77	Wisconsin.....	71.55
Eastern Pennsylvania.....	70.87	Minnesota.....	71.42
Western Pennsylvania.....	72.61	Iowa.....	70.84
New Jersey.....	72.54	Kansas.....	71.65
Delaware.....	74.71	Nebraska.....	76.03
Maryland.....	69.87	Missouri.....	74.74
District of Columbia.....	70.39	Colorado.....	76.13
Virginia.....	71.68	Eastern and Southwestern Dakota.....	75.39
North Carolina.....	71.16	Southern California.....	90.00
South Carolina.....	73.78	Northern California.....	84.94
Georgia.....	77.00	Oregon.....	80.90
Eastern Florida.....	86.77	Washington Territory.....	79.48
Western Florida.....	75.74	By elements:	
Alabama.....	78.84	Weather.....	77.95
Mississippi.....	78.77	Wind.....	76.03
Louisiana.....	83.39	Temperature.....	69.15
Texas.....	82.81		
Arkansas.....	83.32	General average.....	74.24
Tennessee.....	77.71		

* In determining the general average percentage for the different elements, the Pacific coast states have not been included.

CAUTIONARY SIGNALS.

Of the total number of cautionary and storm signals ordered during May, 1888, it was practicable to determine the justification or failure of thirty-seven; justified, twenty-two, or 59.46 per cent. Of the above, thirty-four were ordered for cautionary signals; number justified, nineteen, or 55.90 per cent.

Three storm signals were ordered, all, or 100 per cent., of which were justified. Total number of direction signals ordered, thirty-nine; justified, thirty-four, or 87.18 per cent. Number of signals ordered for easterly winds, twenty-five; justified, twenty-three, or 92.00 per cent. Number of signals ordered for westerly winds, fourteen; justified eleven, or 78.60 per cent. Number of storms without signals, four. Number of signals ordered late, *i. e.*, after the justifying velocity had begun, ten, or 27.03 per cent.

COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered, nineteen; justified, eleven, or 57.90 per cent.

LOCAL VERIFICATIONS.

The following extracts from the published reports of the state weather services for May, 1888, show the percentages of verification of weather and temperature signals for the various states:

Indiana.—La Grange, verification of weather indications, 80 per cent.

Michigan.—Weather and temperature signals are now displayed in one hundred and forty towns in the state, and upon the baggage-cars of twenty-six trains of eight of the principal railroads of the state.

The indications and cold-wave warnings are issued by the Chief Signal Officer and distributed to the different stations through the central office. The indications are issued at 1 a. m., daily, from the Chief Signal Office, Washington, and are for the twenty-four hours from 7 a. m. to 7 a. m.

The percentage of verification of these indications for May is as follows (the verification is taken from reports of displymen furnished this office monthly): temperature, 75.1 per cent; weather, 85.2 per cent.; temperature and weather, 80.1 per cent.

The percentage of verification of weather predictions for May on the D., G. H., and M. R'y, is 81.7 for weather, and 68.9 for temperature; on the C. & G. T. R'y, weather, 82.7, temperature, 78.3; P. H. & N. W. R'y, weather, 81.7, temperature, 80.0; M. C. R'y, weather, 88.3, temperature, 87.5; G. R. & I. R'y, weather, 86.0, temperature, 79.0; C. & W. M. R'y, weather, 81.8, temperature, 85.0; P. O. & P. A. R'y, weather, 84.0, temperature, 79.7. No cold-wave warnings were issued during the month.

Nebraska.—The percentages of correct predictions for the state are as follows: temperature, 84.7; weather, 78.1; mean, 87.4.

South Carolina.—The percentages of verifications of the weather and temperature predictions for the state was: weather, 78.6; temperature, 91.8.

Tennessee.—The percentages of verifications of weather and temperature predictions sent daily from the Signal Office at Washington to the various stations in the state were for the state: weather, 82.7 per cent.; temperature, 79.1 per cent.